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Monitoring Investment Strategy for the Salmon Recovery Funding Board



P R E P A R E D F O R

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Table of Contents

1	INTRODUCTION.....	1
1.1	Background.....	1
1.2	Scope of This Evaluation.....	2
1.3	Primary Components of the Current Monitoring Strategy.....	4
2	EVALUATION OF THE THREE BOARD-FUNDED MONITORING COMPONENTS.....	5
2.1	Evaluation Approach	5
2.2	Findings	5
2.2.1	Effectiveness monitoring.....	5
2.2.2	Intensively monitored watersheds	7
2.2.3	Status and trends monitoring.....	11
2.2.4	Numerical ratings for the “three-legged stool”	13
2.3	Adaptive Management and SRFB-funded Monitoring.....	14
2.4	Thematic Issues, Concerns, and Needs.....	17
2.4.1	Cross-cutting issues.....	17
2.4.2	Specific questions from the Workplan	18
3	THE INTERRELATIONSHIP OF SRFB MONITORING ACTIVITIES TO OTHER REGIONAL MONITORING.....	21
4	INFORMATION TRANSFER	22
5	CONCLUSIONS.....	23
5.1	Opportunities and Limitations of the Present Program.....	23
5.2	Levels of Funding vs. Value Provided.....	24
5.3	Recommended Improvements	25
5.4	Next Steps	26
6	REFERENCES.....	27

Tables

Table 1.	Description of fish in and fish out monitoring in Washington.....	12
Table 2.	Numerical rating of the SRFB monitoring.....	14
Table 3.	Monitoring elements in the regional recovery plans	18

Figures

Figure 1.	The adaptive management cycle.....	15
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Appendices

Appendix A.	Documents Reviewed
Appendix B.	Steering Committee Participants
Appendix C.	Interviews Conducted

1 INTRODUCTION

The purpose of this report is to provide an independent review of the existing monitoring strategy of the Salmon Recovery Funding Board (SRFB, or “the Board”) and to offer recommendations and alternatives that could improve and update this monitoring strategy. This work has been carried out by scientists from Stillwater Sciences (Drs. Jody Lando and Derek Booth) and Cardno/ENTRIX (Stephen Ralph), under contract to the Governor’s Salmon Recovery Office (GSRO), an agency created by the State Legislature in 1999 and presently within Washington State’s Recreation and Conservation Office (RCO). This review was developed in coordination with RCO and GSRO staff and was based on reports and prior reviews of the monitoring of salmon-recovery efforts in Washington State since the late 1990s (Appendix A); conversations with multiple stakeholders and participants in salmon recovery at local, state, and federal levels (Appendices B and C); and our own familiarity with monitoring principles in general and the State’s recovery efforts in particular.

1.1 Background

The SRFB Strategic Plan (Washington State Recreation and Conservation Office, n.d.) articulates three overarching goals for the work of the Board: funding the best salmon-recovery efforts (Goal 1), maintaining accountability (Goal 2), and promoting public support for salmon recovery (Goal 3). Monitoring activities are primarily embraced within Goal 2:

“Be accountable for board investments by promoting public oversight, effective projects, and actions that result in the economical and efficient use of resources.” (p. 2 of the SRFB Strategic Plan)

With respect to the Monitoring Strategy, this goal is further expanded:

“Monitoring Strategy: Provide accountability for board funding by ensuring the implementation of board-funded projects and assessing their effectiveness, participate with other entities in supporting and coordinating state-wide monitoring efforts, and use monitoring results to adaptively manage board funding policies.”

This goal invokes four themes—that of promoting the *effectiveness* of Board-funded activities (which is also the primary focus of Goal 1), demonstrating *accountability* for the expenditure of public funds in pursuit of salmon recovery, working *collaboratively* with other entities to support monitoring, and embracing the principles of *adaptive management*. These themes are interrelated, because ultimately the most compelling justification for taking action is that it produces the intended outcome and materially improves future actions.

Several challenges, however, complicate the simple execution of any monitoring program that seeks to demonstrate effectiveness and accountability, and that works collaboratively to achieve meaningful changes to resource management as a result of its findings. These challenges are best recognized at the outset of any program evaluation such as this one:

- The SRFB is not the sole supporter of salmon-recovery efforts in Washington State, and it also cannot influence some of the greatest recognized determinants of both local and regional salmon populations (e.g., hydropower, hatcheries, land use).
- Individual entities have distinct missions and information needs, and so satisfying the monitoring needs of one will not necessarily address the needs of all. Even though collaboration amongst regional monitoring programs is essential to make best use of practitioners' expertise and the value of measurements, imposition of uniform metrics and protocols (the most common implementation of "collaborative monitoring") rarely benefits all parties equally.
- "Effectiveness" is multi-scalar; even an "effective project" (i.e., one that meets all of its site-specific objectives) may not result in any demonstrable progress in salmon recovery at basin, regional, or statewide scales.
- Most actions, even if fully successful, take many years to produce a measurable response, commonly exceeding the planning horizon (and patience) of most public agencies.
- "Accountability," although ultimately determined by the effectiveness of actions and expenditures, also depends on clear messages that are widely distributed and easily understood by the public. These are not elements normally articulated as goals or specific objectives of a monitoring program.
- Adaptive management, the realigning of a program's goals and actions as a result of outcomes (particularly those that are "unexpected" or "undesirable") requires a deliberate management structure, including explicit feedback loops and mandatory (re)evaluations of planned trajectories, that is uncommon in most public agencies.

With this context, we now offer the details of the scope, approach, and findings of this review.

1.2 Scope of This Evaluation

The original Request for Proposals issued by the RCO in January 2013 specified eight tasks to be accomplished within the scope of this project:

- Task 1. Review the three primary components of the current monitoring strategy used by the Board and assess their effectiveness in meeting the goals of the program.
- Task 2. Evaluate the monitoring components of the seven regional recovery plans and determine which of these components are appropriate for Board funding.
- Task 3. Evaluate how information on the results of monitoring is presently exchanged.
- Task 4. Evaluate how the current Board monitoring fits into the monitoring in Washington being conducted by federal agencies.
- Task 5. Evaluate the current monitoring funding and allocation methods used by the Board, and assess whether the funding for the three primary components is at the appropriate levels.
- Task 6. Evaluate whether (and how) a portion of the monitoring funding should be reserved for alternative methods for allocating funds.
- Task 7. Evaluate the pros and cons of adding additional effectiveness monitoring project sites.
- Task 8. Work with a Steering Committee to be established by RCO.

These tasks and discussions with the steering committee members on March 18 and May 6, 2013, developed into a workplan (Stillwater Sciences 2013) to structure this assessment. The overarching focus of the review anticipated by this workplan, and the bulk of our subsequent efforts, has centered on Task 1—an evaluation of the three primary components of SRFB-funded monitoring. The three components, as articulated in the SRFB Strategic Plan (p. 4 of the Plan), are as follows:

- Conduct monitoring to determine the *effectiveness* of different types of Board-funded restoration and protection projects in achieving stated objectives.
- Participate in supporting *status and trend* monitoring.
- Support validation monitoring of selected *intensively monitored watersheds* to determine whether watershed health and salmon populations are responding to recovery efforts.

The Strategic Plan also supports “implementation (compliance) monitoring of every board-funded project to ensure the project has been completed consistent with pre-project design objectives and criteria,” but this monitoring component was not included in the scope of this review. A separate review of the implementation compliance process is currently being conducted by the RCO/GSRO, Washington Department of Fish and Wildlife (WDFW) and TetraTech.

The three monitoring types highlighted in the Strategic Plan are commonly defined in various agency reports of the last decade as follows:

- *Effectiveness monitoring*, here meaning the evaluation of the local effects (both physical and biological) of a project on its immediate surroundings.
- *Intensively monitored watersheds (IMWs)*, the term given to an integrated suite of monitoring efforts at multiple scales within the same watershed (or set of watersheds), designed to reveal any cause–effect relationships between restoration actions in those watersheds and fish populations.
- *Status and trends monitoring*, which in the context of SRFB-funded efforts is focused on enumerating the passage of fish in and out of the major river systems of Washington State on an annual basis.

In addition, there are several other types of monitoring that are commonly recognized, but which are *not* included in this review:

- *Implementation (or compliance) monitoring*, which evaluates whether a project (or other action) was implemented as intended.
- *Status and trends monitoring* can be used to evaluate conditions of stream habitat and watershed land cover over time, in addition to evaluating trends in fish populations. The former application is not routinely funded by the SRFB.
- *Validation monitoring* is a term used in a variety of contexts: to evaluate more local scales of effectiveness of restoration efforts (i.e., equivalent to status and trends monitoring of regional fish populations) (King County Water and Land Resources Division), or to validate assumptions, models, and methods in a research context (Snohomish Basin Salmonid Recovery Technical Committee; Oregon Watershed Enhancement Board). However, this term is also used as a synonym for the SRFB-funded IMW programs (e.g., in documents from PNAMP).

The three components of SRFB-funded monitoring (effectiveness, IMWs, status and trends) have been described as the Board’s “three-legged stool” for monitoring, and the majority of articulated tasks for this review relate to this framework. The results of our work are thus organized

primarily by these three monitoring types; however, a number of issues related to SRFB-funded monitoring cross-cut these categories (as do several of the secondary tasks of the Work Plan), and so our presentation and discussion of results does not follow this organization in all respects.

1.3 Primary Components of the Current Monitoring Strategy

The *Washington Comprehensive Monitoring Strategy for Watershed Health and Salmon Recovery* (Volume 2 of 3, December

2002; http://www.rco.wa.gov/documents/monitoring/Comprehensive_Strategy_Vol_2.pdf)

established the three-fold framework for all natural resource state agencies, one that has persisted to the present day. It was advanced to answer questions raised by the two articulated goals of the Comprehensive Monitoring Strategy, “Measure changes, in terms of scientific certainty, in wild salmon populations in terms of abundance, diversity, and geographic distribution and their causes due to trends in effects of harvest, hatcheries, ocean conditions, ecological interactions, and large hydropower”; and “Measure changes, in terms of scientific certainty, in water quality, water quantity, watershed health, salmon habitat, and their effects on salmon.”

To implement this framework, alternative approaches were originally considered. Given the recognized shortcomings of local, disparate evaluation of projects, a centralized approach to **effectiveness monitoring** (see above definition) of projects at the reach scale was implemented in 2004 based on a contracted report submitted to the Board by Taylor and Associates (2003), through recurring annual contracts with TetraTech EC Inc. Projects were randomly selected for long-term (typically, 10 years) monitoring across the state after being stratified into nine categorical “types”, with a variety of physical and biological metrics in the locality of the project itself being collected on an annual, biannual, or less frequent schedule as determined by the project type and age.

The **intensively monitored watersheds** program was first funded in 2003 and included the four watershed complexes presently monitored today with Board funding: selected areas of the Strait of Juan de Fuca (SJF), Hood Canal (HC), Lower Columbia (LC), and the Skagit River estuary. An IMW is defined as a “watershed-scale coordinated restoration effort with an associated effectiveness monitoring program implemented in an experimental fashion to maximize the ability to detect fish responses to changes in their habitat” (Desgroseillier et al. 2011). As stated in the Comprehensive Monitoring Strategy (Crawford et al. 2002), “The common theme of these studies is to develop an understanding of the linkage between management actions and the resource” (p. 22), accomplished by monitoring a variety of physical and biological parameters at multiple spatial scales, with the intended concurrent implementation of sufficient habitat-restoration projects that measurable effects on salmonid populations could credibly be expected to occur within about a decade. In 2006 the Independent Science Panel (Report 2006-1, August 31, 2006) conducted a review of the IMW program.

The third element of Board-funded monitoring, **status and trends (also called “fish in–fish out”) monitoring**, was an original element of the Comprehensive Monitoring Strategy (Crawford et al. 2002), with SRFB funding for juvenile monitoring starting in 2001 and the Fish In/Fish Out program starting in 2007. It remains primarily a Department of Fish and Wildlife-funded program, whose “...basic objective is to estimate fish populations, generally at the ESU [evolutionarily significant unit] scale, and to track indicators of habitat, water quality, water quantity, and other factors that impact wild fish.” The SRFB has contributed limited (<10%) funding to this program for most of the past decade, but the focus has been almost entirely on the

first dimension of such monitoring (i.e., smolt counts) rather than on the tracking of habitat “...and other factors that impact wild fish.”

2 EVALUATION OF THE THREE BOARD-FUNDED MONITORING COMPONENTS

2.1 Evaluation Approach

Our evaluation of the monitoring components emphasized four criteria, based on the underlying goals for monitoring as articulated in the SRFB Strategic Plan:

1. What has been accomplished by SRFB-funded activities?
2. Have the monitoring results been used to inform future management decisions?
3. What is the time frame for generating new information useful for management; can monitoring results actually be used/useful?
4. Does the monitoring support a regional context to enhance the interpretation of other monitoring results?

To accomplish this evaluation, we used a variety of approaches: specifically, reviews of documents (Appendix A), structured interviews with key stakeholders and others with long-standing knowledge of salmon-enhancement monitoring in Washington State (Appendix B), and three face-to-face meetings with the RCO-convened Steering Committee for this project (Appendix C).

2.2 Findings

We have organized the presentation of our findings by the three monitoring components evaluated here (effectiveness monitoring, IMWs, and status and trends monitoring). We consider each component in two ways:

1. A descriptive evaluation, using the four criteria listed above; and
2. A numerical rating, structured around the SRFB themes (see Section 1.1) and informed by the above four criteria.

Although we recognize that each criterion does not equally apply to each monitoring component, the set does provide a systematic, structured framework for highlighting what should be the key issues for any monitoring program. We also recognize that a singular score for each monitoring component and theme cannot capture the wide range of performance that exists within each component. That said, the scoring serves as a tool to demonstrate average performance levels and relative differences between the components and within the themes. As such, we believe it serves a useful role to better focus attention on the components with the greatest opportunities for improvement.

2.2.1 Effectiveness monitoring

NOAA (2011, *Guidance for Monitoring Recovery...*) defines *Project Scale Effectiveness* as determining “[w]hether an implemented project is effective in its stated goals: ‘e.g. The installed large wood is working to provide cover and channel alterations.’ This is an outcome of the strategy and may have both a habitat and fish outcome at the project scale. Note that this level of monitoring may be appropriate for groups of projects or sites rather than on an individual project

basis...If designed properly, it tests whether project design features were effective; whether habitat was restored at the project site as intended; whether local fish populations at the project site were improved.” (p. 63)

Effectiveness monitoring is the most “intuitive” and well-defined of the monitoring components in terms of both its objectives and its scope; it occurs at a scale that is readily grasped by scientists and the lay public alike, and the objects of its attention—habitat-restoration projects—are the explicit mission for the SRFB. Thus, its long-standing inclusion in the monitoring portfolio of the SRFB is fully warranted and widely supported.

2.2.1.1 The four criteria

What has been accomplished by SRFB-funded monitoring activities?

The Effectiveness Monitoring Program receives ~11% of the 2011-2013 total SRFB monitoring budget and has been quite successful in defining and executing a systematic program of project-scale assessments. Working from a matrix of projects grouped into each of several project “types,” most of the project monitoring plans follow a schedule of yearly visits to each site at Years 0, 1, 2 (or 3), 5, and 10. With some projects not having been implemented until 2011, the current schedule is not anticipated to be completed until 2020, although the number of remaining projects starts to drop rapidly after 2014. Annual reports for each project visited and an annual summary of the monitoring for all projects from the prior year are regular written products, together with oral presentations before the SRFB and at regional conferences.

Reviews of a subset of these written products show a common, systematic presentation framework that emphasizes the “accountability” element of monitoring—the methods, the results, and a summary of observed changes since the prior visit are summarized in narrative text, maps, and graphs. Confirmation of the project’s implementation is easy to accomplish, and any broad trends in local reach-scale metrics (e.g., LWD, channel dimensions, vegetation survival) are readily apparent. Reports are archived and can be accessed through the web-based “Habitat Work Schedule” (<http://hws.ekosystem.us/>).

Have the monitoring results been used to inform future management decisions?

We have found no evidence of any systematic feedback, or “adaptive management loop,” associated with the Effectiveness Monitoring Program, although many participants and other users of the information have reported anecdotes of how the results have been used. There is little doubt that informal contacts are occurring between monitoring crews and project designers in the field, and between presenters and their audience in conferences—but these are overwhelmingly *ad hoc* in character, suggesting that opportunities for more systematic integration of past findings into upcoming decisions are being missed.

Opportunities are also being missed to generalize the findings of the effectiveness monitoring into a form that could be more useful to others. Consider, for example, the entire “Summary” section from the Year-8 evaluation of Project 02-1622 (Issaquah Creek Log Cabin Reach Acquisition) in 2012:

“Overall, in-stream conditions in Year 8 (2012) appeared to be relatively similar to what was observed during previous years’ monitoring, however, the stream is migrating, as evidenced by the undercutting of the left bank, inputting sand into the system. The vegetation at the Issaquah Creek project in 2012 has not changed substantially since 2007. However, deciduous trees are continuing to fill in the edges of the grassy fields at the southern portion of the site, and conifer plantings on the

eastern slope have been installed. Over time, these will likely help to decrease the abundance of non-native species in this area. Year 12 monitoring of this site is scheduled for 2016.”

Within this project type (“Habitat Protection”), the Summary Report for this same year notes that:

“Determining the effectiveness of Habitat Protection Projects is difficult since there is no restoration action implemented at these sites. Change may occur slowly, or may not occur at all if conditions are maintained. Furthermore, a decline in conditions may not be the result of actions taken on that parcel, but rather outside of the protected area.” (p. 35)

In total, such reporting generates clear demonstration of accountability and successful project implementation, somewhat more ambiguous conclusions concerning project effectiveness, and very little to guide future management decisions. This final shortcoming is in part a consequence of the lack of formal structures to require that it occurs, and in part because the synthesis documents appear to lack having “application to future projects” as an explicit objective. At present, reports are largely data repositories with a strong preference for highlighting positive outcomes; they show little effort to generalize findings, positive or (particularly) negative, in a way that could be used by other designers or reviewers, or to evaluate existing hypotheses or to reframe more appropriate ones.

What is the time frame for generating new information useful for management; can monitoring results actually be used/useful?

Of all of the monitoring types, the results of effectiveness monitoring should be the easiest to transform into useful, timely guidance. To some degree this has already occurred within this program, and the value of such applications are widely recognized. Although the some project reports include appropriate acknowledgment of the need for “more time,” presumably not every study needs 10 years to return meaningful (even if negative) results. Recognition of this fact has been implemented to some degree (i.e., by the termination of some project monitoring already showing clearly beneficial results) but not as an outcome of a systematic evaluation.

Does the monitoring support a regional context to enhance the interpretation of other monitoring results?

This question is least relevant to project-scale effectiveness monitoring and so was not considered in the course of this evaluation. Effectiveness monitoring, in general, ultimately plays only a “supporting” role in achieving and documenting improvement in salmon populations, as originally recognized and articulated in documents from the last decade. The successful administration and regular reporting of this monitoring component has suggested to some that its role should be expanded, but reach-scale effectiveness monitoring is inherently limited in what it can accomplish—and without more rigorous analysis and reporting, with specific attention to making the results more generally useful to future projects, even this limited utility is not being fully exploited.

2.2.2 Intensively monitored watersheds

As originally articulated in the 2001 Comprehensive Monitoring Strategy document, “Intensive (validation) monitoring ...is tailored to establish “cause and effect” relationships between fish, habitat, water quality, water quantity, and management actions.” (p. 22) This effort has been implemented in Washington State through *Intensively Monitored Watersheds*. As of 2013, the

SRFB funds IMW monitoring in four watershed complexes: three adjacent tributaries draining to the Strait of Juan de Fuca (SJF), four adjacent tributaries draining to Hood Canal (HC), three adjacent tributaries to the Lower Columbia (LC), and the Skagit River estuary (Skagit).

“This part of the SRFB Monitoring Strategy [i.e., Intensively Managed Watersheds] pertains to monitoring that addresses how management and habitat restoration project activities, and their cumulative effects, specifically affect fish production. As is discussed in greater detail below, validation monitoring (or as termed here, intensive monitoring) is the only way this can be achieved (ISP 2002)... Other types of monitoring are unable to answer questions like ‘to what extent did our recovery actions lead to more fish?’

“The SRFB intends to support intensive monitoring in watersheds carefully chosen to allow efficient and meaningful results...” (from the 5/23/2003 report, Monitoring and Evaluation Strategy for Habitat Restoration and Acquisition Projects, p. 6-7)

And, as more explicitly stated in the 2013 summaries of the IMW program (e.g., Intensively Monitored Watersheds Synthesis Report, Lower Columbia River, 2013), “The goals of the IMW Program are to determine whether freshwater habitat restoration actions, as currently conducted in Washington state, measurably increase salmonid survival and production and to explain why or why not. The basic premise of the IMW Program is that the complex interactions between salmonids and their habitat can best be understood with concentrated monitoring and research efforts at a few locations.”

2.2.2.1 The four criteria

What has been accomplished by SRFB-funded monitoring activities?

IMWs have been the largest single component of the SRFB monitoring budget (for example, it was ~56% of the 2011-2013 total SRFB monitoring budget). IMW monitoring is also the most ambitious, insofar as it seeks to establish a robust, scientifically defensible and causal linkage between restoration actions and recovery of salmonids populations (Bilby et al., 2004). The approach has an excellent scientific foundation, with the documents that established this program providing good rationale for their inclusion in the mix of SRFB-funded monitoring, systematic evaluation of quantitative criteria, and statistical justification for a likely decadal timeframe for showing results.

The accomplishments of this monitoring component, however, have been severely hampered by the general lack of “treatments” (i.e., habitat restoration projects) in most of the target watershed complexes. In this respect, two of the IMWs have been most problematic. This is evident from the executive summaries to the watershed-specific Intensively Monitored Watersheds Synthesis Reports, which acknowledge the paucity of on-the-ground treatments to date:

“In Little Anderson Creek, completed restoration projects include one culvert replacement and two large woody debris additions. In Seabeck Creek, completed and in-progress restoration projects include three culvert replacements and one undersized bridge replacement. In Big Beef Creek, final plans are being developed to remove bank armoring and reconnect a wetland in the lower watershed.” (Hood Canal report, p. 7)

“Few physical habitat restoration treatments have been completed. However, in Germany Creek a blocking culvert was replaced and a bank was stabilized with bioengineered armoring by Sierra Pacific Industries on their land. The Columbia

Land Trust also restored some side channel habitat in 2009 and armored a tidal portion of the mainstem using concrete dolos in 2012. Restoration was initiated in Abernathy Creek in 2004 with a road abandonment followed by limited riparian invasive species removal and replanting in 2008.” (Lower Columbia report, p. 1)

Both the analysis of limiting factors, and the subsequent project implementation focus on projects in the Skagit estuary, have been more comprehensive and complete than those of the other three SRFB IMWs. It has some inescapable shortcomings—the schedule for full project implementation is many decades into the future, and it is a before-and-after design with no ability to compare to a control or reference stream or estuary. However, the projects are addressing what is widely judged to be the most important limiting factor, and the monitoring program should be able to determine if Chinook populations are increasing with restoration within a credible length of time.

Given limitations on project implementation throughout most of the other IMWs, and thus the absence of any credible expectation for systemic responses, the IMWs have generally met only those objectives of collecting a diversity of physical and biological data. In time, these data could presumably be integrated into a meaningful understanding of restoration–population linkages, but in general this has not occurred and the prospect for meaningful results is still many years into the future. Some results provided for some of the IMWs (in particular, HC and Skagit) show promising responses, but none are yet able to articulate any defensible conclusions.

Have the monitoring results been used to inform future management decisions?

We find no evidence of IMW results influencing management decisions, likely for two reasons. First, insufficient time has passed since the implementation of restoration projects to expect monitoring to reveal significant effects. This is only partly a consequence of the program’s duration (not quite 10 years)—mainly, it reflects the slow pace at which projects have been implemented in most of the target watersheds, even after the program was initiated. We return to this underlying problem below.

The second reason for the general lack of influence being exercised by IMW findings is the lack of any systematic, widespread dissemination of results, and the absence of any formal feedback mechanism to make use of such results even if they were/are available. For example, we have identified three “synthesis reports” as referenced above for HC, LC, and SJF, all published in 2013, but their distribution is uncertain and they have no apparent precedent in the history of any of the IMWs. The Skagit has an extensive list of project-specific reports, accessible on the Skagit System Cooperative web page (<http://www.skagitcoop.org/index.php/documents/>), but this collection is not IMW-specific and appears to include every document produced by the Skagit Cooperative on any subject for the past 15 years. Although surely convenient for active workers in this region (who likely maintain an active, informal network for sharing information), it is a daunting archive for “outsiders” seeking to learn from the Skagit experience.

We have been introduced to a variety of irregular and/or informal settings wherein information is shared (such as at the recent IMW workshop hosted by the Pacific Northwest Aquatic Monitoring Partnership [PNAMP]). The focus of these exchanges appears to be most strongly on the methodological advances and the evaluation/documentation of the effectiveness of a set of treatments on a particular group of streams. Even in the Skagit, where we have found the greatest level of documentation, the utility of presented results for future management is limited. For example, a recent PNAMP presentation (“The Skagit IMW: Examining the Effects of Estuary Restoration on Chinook Salmon” by Greene and Beamer) apparently follows historical patterns of detailed oral/PowerPoint presentations but without readily accessible, systematic written

documentation elsewhere. The Skagit is also unique in its scope and size, and there is no indication of direct feedback or cross-pollination between it and other IMWs. The 2007 study plan for the Skagit IMW states “Lessons learned in the Skagit estuary could benefit recovery efforts in other Puget Sound Chinook salmon bearing rivers. This should be true in places that have the same habitat and life history types as the Skagit, although out of system transferability will need to put in a river specific context” (p. 6). However, it also notes that the Skagit is unique amongst the other three SRFB-funded IMWs, and it identifies NMFS as the lead for identifying whether, and to where, the results from this watershed could be extrapolated.

What is the time frame for generating new information useful for management; can monitoring results actually be used/useful?

The IMWs, in both the original defining documents and the individual reports, have always been careful to articulate a roughly decadal time frame in which scientifically defensible results could be generated. For example, the 2007 SJF study plan presumed that “up to 10 years” would be needed to see statistically meaningful results. Monitoring began in 2004, which might suggest that another year or two from the present should now be sufficient. However, the last project is not scheduled for implementation until 2013. This decadal time frame was determined by a power analysis and it appears robust. However, slow pace of implementation, episodic large storms, and expectation that biological response will lag physical changes suggest that yet longer time could be needed to show any fish response.

These are issues not unique to the SJF IMW. The HC study plan anticipates 10 years of monitoring to detect any changes, with an initial analysis in 2010. This plan likely did not anticipate implementation to proceed so slowly (2007–2009 being the main treatment period). Post-project monitoring on Seabeck Creek was not even scheduled to begin until 2013. The 2013 LC summary states, “Within seven to ten years following the completion of restoration treatments the IMW project should reliably determine whether restoration treatments increase salmon survival and production and provide valuable guidance that will improve the efficiency of future habitat restoration that is intended to increase salmon survival and production. To ensure the success of the IMW Program and reduce the cost of long-term monitoring, restoration treatments must be implemented in the IMW treatment watersheds and ongoing monitoring must continue.” The anticipated time frame is thus about a decade *following* the last treatment, a restoration trajectory that by some measures has barely begun.

Does the monitoring support a regional context to enhance the interpretation of other monitoring results?

This criterion is of potential relevance to the IMWs, and it was apparently an articulated potential benefit of this program at its initiation. The intent was to have IMWs located in various geographic regions and ecotomes in order to help predict recovery response for a variety of limiting factors for both westside and eastside environments. Although each IWM watershed complexes support only a small fraction of the populations that utilize them (with the exception of the Skagit), they are credible analogs for small- to medium-sized westside watersheds. However, we have found no indication that this potential is being explored in other watersheds, or even that it is a recognized objective for the three “small” IMWs (i.e., HC, LC, SJF) as expressed in their respective 2013 Synthesis Reports. Monitoring of the Skagit could, credibly, contribute to a regional understanding of Chinook populations in Puget Sound, although this application also has not been evident in the reporting to date.

2.2.3 Status and trends monitoring

NOAA (2011, Guidance for Monitoring Recovery...) defines status and trends monitoring as a way to “assesses changes in the condition of a metric important for tracking progress in a population or listing factor. It is the main monitoring necessary to determine the biological condition of the species and the status of specific statutory listing factors and threats.” More specifically, status monitoring characterizes the condition of physical, chemical, or biological attributes across a given area at a single point in time (e.g., abundance of fish at time x in a watershed). Trend monitoring determines changes in biota or conditions over time (Roni, 2005). Status and trends data also can provide high-level indicators that can be easily understood by the public and policy makers and are used to plan and inform management and restoration actions.

2.2.3.1 The four criteria

What has been accomplished by SRFB-funded monitoring activities?

WDFW collects status and trend data for juvenile, smolt and adult fish in each ESU for each listed species. The primary use of the fish information is to track abundance, productivity, diversity, and spatial structure of listed populations in major population groups. The regularity of the data collection and the high quality of the data are successful attributes of this program. By quantifying abundance, productivity, distribution and diversity paired with restoration projects, status and trend data can integrate the recovery boards and lead entities habitat actions with monitoring. Within most of the regional salmon recovery plans, status and trend data for fish and habitat are identified and meaningful questions are being discussed.

Starting in 2001, SRFB funding was used to complement WDFW fish sampling (coined “Fish In/Fish Out”) for populations that would not otherwise be monitored. The financial allocation for status and trend support by the SRFB varied for many years; however, in the last three years, SRFB funding has been stable and consistently applied (e.g., Hood Canal monitoring for juvenile summer chum). Currently the SRFB provides \$208,000 (about 8% of the 2011-2013 total SRFB monitoring budget) of the total \$3 million spent annually on status and trend monitoring statewide. In order to manage the ongoing sampling programs within the Fish In/Fish Out framework, WDFW updates and evaluates an annual table of status and trend sampling to identify gaps and priorities. Such a process helps supporting organizations such as the SRFB to know where best to allocate available funds.

An example of the type of data generated from the Status and Trend Monitoring Program is shown in Table 1 (Table 4 of Crawford et al. 2007). This table is updated annually to reflect changes in population structure and plan forthcoming sampling efforts. Gaps in monitoring are given high priority using the following criteria:

- Primary populations that are the only source of juvenile and adult monitoring per major population group (MPG) per evolutionarily significant unit (ESU) are given higher priority than all other populations within the ESU.
- Monitoring locations where previous year’s data exist for a specific species and lifestage (data continuity) are given higher priority than initiating a new monitoring project.
- Projects with no alternative source of funding (e.g., Hood Canal summer chum juvenile monitoring) are given higher priority than projects with alternative sources of funding.

Table 1. Description of fish in and fish out monitoring in Washington (from Crawford 2007).

Statewide monitoring of listed species—juveniles & adults												
2/13/2007 10:34					Proposed for FY07-09 GF-S Funding							
					Proposed for FY07-09 GF-S and submitted for BPA funding							
					Submitted for BPA funding							
Recovery region	Major population groups	WRIAs	Target species	Primary populations	Juveniles				Adults			
					Smolt sites	Production	Smolt trapping agency	Funding	Spawners (Stocks)	Data quality	Monitoring agency	Funding
Puget Sound	North Sound	1 to 2	Chinook	NF Nooksack	Nooksack	Index	Lummi	Tribal	NF/MF Nooksack	Very Good		GFS
				SF Nooksack					SF Nooksack	Very Good		GFS
									Samish/MS Nooksack	Poor		
	Whidbey Basin	3 to 7	Chinook	Upper Skagit	Skagit	Yes	WDFW	Federal (Dingall/ Johnson) 50% Seattle PU 50%		Good		
				Lower Skagit					Upper Skagit MS/Tribs	Very Good		
				Upper Sauk (early)					Lower Sauk	Good		
				Lower Sauk					Upper Sauk	Excellent		
				Suiattle (early)					Suiattle	Excellent		
				Cascade (early)					Upper Cascade	Excellent		
				NF Stillaguamish	Stillaguamish	Yes	Stillaguamish	Tribal	NF Stillaguamish	Good		GFS

Have the monitoring results been used to inform future management decisions?

In some cases status and trend monitoring has informed future management. For example, the Skagit River has had a successful history of long-term status and trend monitoring, particularly adult abundance, with integrated fish monitoring and habitat restoration (Skagit Chinook Recovery Plan 2005). This integration subsequently has resulted in a focus on the estuary as the most significant limiting factor. Such success is not as clear for other watersheds that collect similar data but lack integration between fish monitoring and the selection of habitat-restoration actions.

Another challenge with status and trend monitoring lies with the articulated purpose(s) for the monitoring. To date, the focus on status and trend monitoring (as funded by WDFW and SRFB) has been to document net biological results (i.e., numbers of fish). Little progress has been made towards evaluating those results and asking meaningful questions of purpose (e.g., are we monitoring the right lifestages in the right places? What are the limiting factors that might respond to changes in habitat conditions?).

What is the time frame for generating new information useful for management; can monitoring results actually be used/useful?

Status and trend monitoring is explicitly intended to compile long-term adult and juvenile fish population data at a watershed scale. The longer the time series, the more opportunity for analysis. That said, we have found little discussion of the recommended duration of status and trend sampling, or the point at which monitoring results would become statistically robust and useful. Despite the absence of much explicit discussion of time frames for utility, we note that status and trend monitoring results are actively being used to inform management (e.g., steelhead data in the Lower Columbia are informing watershed management planning and process; coho data are used to forecast run sizes throughout Washington State).

Does the monitoring support a regional context to enhance the interpretation of other monitoring results?

Status and trends monitoring provides a unique source of fish population data over large spatial and temporal scales. The information collected is directly in line with the SRFB goals. The challenge is to clearly identify how the data can be linked to other scales of monitoring in order to utilize data and justify its continued support from SRFB. It is not enough to simply collect the data.

2.2.4 Numerical ratings for the “three-legged stool”

In an effort to distill a large volume of information into a tractable summary assessment, each of the three legs of the monitoring stool were evaluated based on their success to date at meeting or supporting the articulated themes for SRFB monitoring (accountability, effectiveness, collaboration, and adaptive management). The scores were assigned by the project team using a 5-point scale, based on our professional judgment using information provided by the steering committee, document review, and interviews conducted with key stakeholders and others with long-standing knowledge of salmon-enhancement monitoring in Washington State (see Appendices A–C).

Table 2. Numerical rating of the SRFB monitoring.

Monitoring component	SRFB monitoring themes (see Section 1.1)*			
	Effectiveness	Accountability	Collaboration and communication	Adaptive management
Effectiveness Monitoring	3	4	4	2
IMWs	2 (4 Skagit)	2	3	2 (4 Skagit)
Status and Trends	3	3	3	2

* Level of performance is scored from low (1) to high (5), using the following generic criteria:

- 1 = no evidence of support for this theme
- 2 = minor support for theme but with only limited effectiveness
- 3 = supportive of theme, but with significant opportunities for improvement
- 4 = highly supportive of theme; limited improvements warranted
- 5 = fully supportive of theme, no changes warranted

Although we do not find any of the programs to be completely lacking in support for these themes, several challenges for the overall SRFB monitoring program are highlighted by this summary. We recognize the programs operate under disparate timelines, but believe they can still be held accountable for addressing each of the SRFB monitoring themes. The near uniformity of “2’s” for the theme of adaptive management reflects our judgment that meaningful feedback of monitoring results into future actions is critically deficient and requires substantive consideration by the Board. Although the Skagit was independently scored for two themes due to a distinct level of performance, the generally low ratings for IMWs lead us to some key recommendations for decision-making by the Board. The positive scores for effectiveness monitoring emphasize the success of this component in disseminating results, but it has yet to achieve its potential for driving fundamental improvements in the implementation of restoration projects. Status and trends monitoring, as a program only marginally under SRFB direction, could nonetheless benefit from a thoughtful assessment of its potential benefits beyond the mere annual tallying of fish.

We return to these overarching issues in greater detail in the sections that follow.

2.3 Adaptive Management and SRFB-funded Monitoring

Project funding decisions, monitoring, data analysis, decision-making, and accountability are all disconnected activities under the present operating structure of the SRFB. Each of these activities tends to happen in a different place, or not at all. This is a fundamental obstacle to the creation and execution of an effective adaptive management program. Moving the basic decisions for project selection from a centralized, SRFB-run program out to the Regions may have been a well-guided effort to improve the design and implementation of projects; but without the monitoring program following suit (*also* for good reasons), this action has had the unintended consequence of severing any intrinsic connection between the two—it retains the possibility for *ad hoc* feedback but provides no mandate for it.

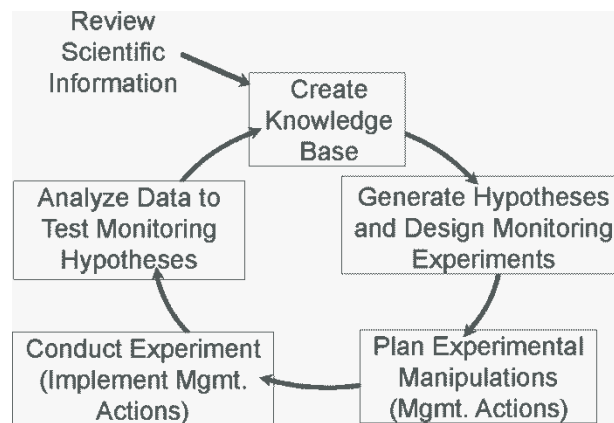


Figure 1. The adaptive management cycle (from Ralph and Poole 2003).

Consider a representation of the adaptive management cycle, reproduced above (Figure 1) from Ralph and Poole (2003, their Figure 3). The links between each step are critical to having a successful program, but many have noted how difficult they are to implement, even under the best of circumstances. However, those links are particularly challenging to implement when they connect activities being conducted by different entities. We believe these disconnections lie at the root of many of the issues that limit the overall value of the present monitoring program.

These challenges are particularly evident in the IMW program. Its most successful aspects are widely recognized to be its scientific rationale, a foundation that was carefully documented in reports from the early 2000's, affirmed by the ISP review in 2006, and no less compelling today. This foundation was executed through the well-coordinated *Washington Comprehensive Monitoring Strategy For Watershed Health and Salmon Recovery*, which continued from initial guidance documents through the generation of hypotheses and monitoring experiment design for the initial SRFB-funded IMWs (SJF, HC, LC). The next step, the planning of experimental manipulations in each watershed, was executed by smaller teams that had only partial overlap with the initial hypothesis-generating team.

Most problematic, however, is that the funding and execution of the management actions was entirely removed from these prior steps. This created what the ISP in 2006 called "Serious weaknesses [in the]...apparent disconnect between how treatments (i.e., the habitat improvement actions) are selected and funded, in relation to experimental design and monitoring needs, and uncertainty about the duration of the commitment to fund the long-term nature of the IMW program." (ISP 2006, p. 1) The responsibility for data analysis returns from the SRFB to the individual IMW study teams, but we find only limited examples across the four IMWs that such analyses have been systematically executed, and even less evidence that they have been formulated and released so as to contribute to the preexisting "knowledge base" (see Figure 1) even were such a repository of such information to be identifiable. A procedure to generate and/or refine hypotheses and monitoring experiments may exist within each IMW working group, but forums for cross-fertilization amongst the multiple IMWs in Washington State (funded by both the SRFB and NOAA-PSMFC) have been slow in development and seemingly informal in past execution.

Thus, IMWs began with a strong scientific mission and have executed varying levels of scientific analysis, but they have no influence of the funding priorities and so they can't actually answer the

questions they were designed to answer (indeed, key questions for salmon recovery that *only* they are able to answer).

The Effectiveness Monitoring Program, in principle, aligns more closely to the adaptive management cycle depicted above, and its widespread support undoubtedly derives in part from its consistency and coherence within that framework. Its foundation was also established by the strategic assessment of monitoring needs in the early 2000's, with hypotheses, plans, and treatments all implemented within a few years under the overarching auspices of the SRFB monitoring program. However, we have seen only modest efforts to analyze the data so collected, and even less of an attempt to add to a "knowledge base" that could inform, except on an *ad hoc* basis, the development of new understanding and (ultimately) better projects.

In the case of the Effectiveness Monitoring program, this disconnection has not been a result of a diffusion of responsibility across multiple entities, as in the case of IMWs, but rather a lack of any credible impetus to "drive" the adaptive management cycle forward. Although monitoring was first (2000) argued as necessary to provide accountability to funding agencies and the public, who were expected to demand some demonstration that the funds were creating a genuine, measurable improvement in salmon habitat and salmon populations, this has not happened in fact. We see few substantive calls today for accountability from either the PCSRF, which distributes money to the SRFB provided by an annual Congressional allocation; or from the public, who sees little reason to complain about a distantly funded program that provides jobs and a sense of nominally beneficial actions—an attitude reinforced by publications such as the State of the Salmon, which combine such broad metrics of "miles of stream treated" and "dollars spent" with high-level indicators as "number of fish in Puget Sound" that no credible inferences can be drawn about the actual effectiveness of state-funded recovery actions. Making those causal linkages should be the role of the IMWs, but they have not been implemented in a fashion that actually serves this purpose.

Consider, by way of contrast, the Regional Stormwater Monitoring Program (RSMP), in the early phases of implementation under the current round of Phase 1 and Phase 2 NPDES permits. In many ways the RSMP is analogous to the Effectiveness Monitoring Program of the SRFB (although it was built from the bottom up [i.e., by the affected jurisdictions themselves], not the top down [i.e., from the state or federal regulators]): local entities pool resources, centralize the development of a monitoring strategy that results in a few individual, "characteristic" projects being monitored by a centralized entity, with results being used to inform all. In our view, its fundamental differences from the SRFB Effectiveness Monitoring Program stem from the regulatory context in which they are each embedded: for the RSMP, there is a genuine threat of consequences for inadequate monitoring or failed project effectiveness (through the NPDES permit requirements on the implementing jurisdictions) and a clear mechanism for relatively prompt feedback (DOE has demonstrated a history of upgrading 5-year permit requirements based on the information collected in previous permits). Contrast this with the SRFB Effectiveness Monitoring program, which was developed under a concern for accountability that has never truly materialized, and for which permit requirements (presumably under the ESA) are diffuse and largely unconnected from the agencies conducting the work. We also note, however, that full implementation of the RSMP has not yet occurred, and successful "closure" of the adaptive management cycle is by no means guaranteed here, either.

In summary, local examples are available to demonstrate a successful implementation of the adaptive management feedback: in the case of stormwater monitoring, the work of measurement and analyses are done by the regulated permittees, who are required by their permits to come to management conclusions. In turn, the subsequent permits are changed substantially every cycle

based on what has been learned in past permit cycles, through the implementation by technically knowledgeable Ecology staff. Curiously, we note that this process been more successful for stormwater than for salmon recovery. We speculated that in large measure this likely reflects the more litigious environment of Clean Water Act regulations, and perhaps the greater financial resources (over \$1M for the annual implementation of stormwater effectiveness monitoring); despite the distant regulatory threat of the Endangered Species Act, there has been little impetus for concerted action with respect to habitat monitoring. In addition, the chain of accountability is much shorter for stormwater: ongoing support for the NPDES permit program is provided by the permittees themselves, whereas the monitoring programs of the SRFB have seen continued, annual funding by the US Congress.

2.4 Thematic Issues, Concerns, and Needs

2.4.1 Cross-cutting issues

Project implementation in IMW watersheds need to be accelerated, or the IMW(s) need to be abandoned. This recommendation was made by the ISP in 2006, and it is as true today as it was 7 years ago. As presently implemented, the IMWs are unlikely to provide useful management information or compelling accountability for the expenditure of SRFB funds. To prioritize the implementation of these projects, however, would require a change in the SRFB's present approach to the regional allocation of funds, with the selection and sequencing of projects largely determined by the lead entities. This "regional" approach, no matter how supportive of other SRFB priorities, is simply inconsistent with implementing a successful IMW program. Thus, a clear policy-level decision needs to be made about how best to reconcile these competing priorities to avoid the continued inefficiencies and loss of opportunity inherent in the current approach.

Effectiveness monitoring needs to better demonstrate its value to salmon recovery. Because this type of monitoring is so intuitive, and the program's execution has been so competent, it has escaped some of the closer questions that should be raised with any such effort: What do we learn by monitoring the habitat condition of streams? What's the scientific question that drives the data collection? How do we know that the projects being built, and their local "effectiveness," actually matter to the health of salmon populations? How are the results being used to design and select better projects? Until these questions can be answered, the focus of this program should be on how to make it better, not larger.

Every monitoring program should identify specific time frames for delivering meaningful results. All monitoring should be initiated with an explicit statement, ideally based on statistical analysis or prior experience, of the likely duration of monitoring needed to return meaningful results that can be used to demonstrate outcomes or provide guidance to future projects. Although such preliminary estimates should always be subject to revision as new data are collected, establishing clear expectations for monitoring should be a recognized component of any new data-collection initiative.

Monitoring programs should evaluate the quality of the data being collected with respect to specific monitoring objectives. Although important, it is insufficient to consider the geographic location, species and frequency of monitoring efforts. The SRFB should require that monitoring programs evaluate the quality of the data being collected and explicitly tie the evaluation to clearly articulated monitoring objectives. Without such a linkage, it is quite possible that monitoring efforts will not advance the goal of salmon recovery.

SRFB-funded monitoring should demonstrate accountability beyond implementation.

“Accountability” includes reporting on monitoring effectiveness, collaboration, and adaptive management. Improvement is needed in each of these areas for all types of monitoring (although some more than others). A systematic process of documenting such information would significantly advance the monitoring benefits.

Communication is essential, and presently inadequate. The majority of monitoring data is accessible to only a minority of people. With limited time and resources, valuable monitoring data are not being appropriately disseminated; as such, any potential for adaptive management cannot function as intended.

SRFB monitoring should substantively engage with the Pacific Northwest Aquatic Monitoring Partnership (PNAMP) to advance collaborative opportunities and benefit from the collective efforts of the region. PNAMP is a forum to facilitate collaboration around aquatic monitoring topics of interest, promote best practices for monitoring, and encourage coordination and integration of monitoring activities as appropriate. The forum’s activities are conducted by participant working groups and teams as endorsed by the partner-based steering committee. Participation in PNAMP is voluntary, but widespread. Signatory partners include BPA, California Department of Fish and Wildlife, Columbia River Inter-Tribal Fish Commission, Colville Confederated Tribes, Idaho Department of Fish and Game, NOAA, Northwest Power and Conservation Council, Northwest Indian Fisheries Commission, Oregon Watershed Enhancement Board, Pacific States Marine Fisheries Commission, Bureau of Land Management, Environmental Protection Agency, United States Army Corps of Engineers, United States Bureau of Reclamation, United States Forest Service, United States Geological Survey, Washington State Department of Ecology, WA GSRO/RCO, WDFW.

2.4.2 Specific questions from the Workplan

Which of the monitoring programs of the seven regional recovery plans are “appropriate” for SRFB funding, given the Board’s mission and mandate (Task 2 of Workplan)?

The seven regional recovery plans have varying levels of ongoing monitoring, as summarized in Table 3. This element of the workplan was not assigned a high priority, and thus our evaluation consisted only of a cursory review of readily available recovery plan documents.

Table 3. Monitoring elements in the regional recovery plans.

Recovery plan	Program element	Level of monitoring (low to high, 0 to 3)
Lake Ozette	Status & Trends	0*
	Implementation & Compliance	0
	Effectiveness	0
	Validation	0
Lower Columbia	Status & Trends	2
	Implementation & Compliance	1
	Effectiveness	2
	Validation	1

Recovery plan	Program element	Level of monitoring (low to high, 0 to 3)
Middle Columbia	Status & Trends for Steelhead	2
	Implementation & Compliance	0
	Effectiveness	0
	Validation	0
Upper Columbia	Status & Trends	3
	Implementation & Compliance	0
	Effectiveness	3
	Validation	0
Puget Sound	Monitoring varies by sub-watershed	
Hood Canal	Status & Trends	1
	Implementation & Compliance	2
	Effectiveness	1
	Validation	0
Snake River	Status & Trends	3
	Implementation & Compliance	1
	Effectiveness	3
	Validation	0

* Ozette sockeye are the only ESA listed species in this region; therefore, PCSRF money is limited.

Any expansion of funding in support of regionally-focused monitoring as suggested by this workplan element, however, should be predicated on the assumption that such monitoring data flowing from the efforts of the regional recovery boards would amplify, support and expand on the existing triad of programmatic monitoring efforts currently supported by the SRFB. Given our assessment that the three existing SRFB-funded monitoring components as currently organized lack a common set of objectives, lack sufficient analysis of results, and have not been well-integrated with each other, it is premature to recommend further funding of regional monitoring efforts. Additional support for regional efforts that focus on understanding how specific restoration actions might vary by geographic context, while laudable, can only be useful when there exists an organized and coherently designed overall monitoring program that addresses a common set of objectives, and that yields complimentary and relevant evidence in support of adaptive management. If monitoring results have yet to become relevant to management decisions, there is little justification to expand efforts to collect data.

In summary, this question highlights a more fundamental issue with the current SRFB-funded monitoring efforts. If the institutional capacity does not exist to use the monitoring results to improve decisions on how to spend scarce restoration dollars on the most effective restoration actions, then the first step must be to address this critical shortcoming in existing monitoring efforts. Expansion is a question for a much later date.

Are relative funding levels appropriate and commensurate with the utility and application of the results (Task 5 of WP)? In particular, should additional effectiveness monitoring project sites be added (Task 7 of WP)?

In recent years, funds for SRFB monitoring have followed a relatively steady pattern (\$2.2–2.8 million from 2011-2013). This reflects the NOAA minimum mandatory requirement that at least 10% of PCSRF funds to be allocated to monitoring. In general, IMWs receive half or more of the annual allotment, reflecting the variety of monitoring activities conducted in the IMW watersheds, and the need for detailed annual information if their scientific objectives are ever to be achieved. We have not conducted a detailed audit of monitoring expenditures across the four SRFB-funded IMWs; as noted previously, the disconnection between project implementation and IMW timelines is far more critical an issue than any details of how monitoring funds are allocated.

Of the two other SRFB-funded monitoring components being addressed in this review, effectiveness monitoring is the next largest cost item (~11%). Although the most successful of the components to date, at least as evaluated by our four criteria with respect to the monitoring themes of the SRFB Strategic Plan, its utility within the framework of statewide monitoring is ultimately limited—the statewide uniformity of hypotheses, study questions, methodology, and metrics is defensible from a statistical-power perspective, but the limitations of such an approach are also clear given the diversity of aquatic systems across the state. The current Effective Monitoring program has not demonstrated that the statewide amalgam of projects into presumably homogenous “types” has generated results any more useful than those being executed more regionally and with a more targeted set of questions (e.g., King County, or the estuary program of the Skagit [i.e., the Skagit IMW]). Thus, nothing in the execution to date of this program suggests that its further expansion as a statewide program would produce commensurate benefits.

We note that other, more regionally focused effectiveness monitoring programs are being explored or established. The SRFB could have a relevant interest in providing support for these regional efforts, but without clear indications that the lessons of the present program have been fully incorporated into any new framework—particularly the importance of systematic data analysis, meaningful synthesis of results for future management application, and a clear feedback between monitoring results and future management actions—such an additional investment would not be likely to translate into greater utility or applicability.

Are opportunities for additional program value being missed through insufficient opportunities for funding (either out-of-cycle or competitive funding opportunities) (Task 6 of the WP)?

Although we have neither seen nor heard any direct communications about such alternatives, the existence of a standing funding source will always invite consideration of changes to the *status quo* for allocating resources. There is ample precedent for alternate methods of funding allocation in both state and federal agencies (for example, the National Science Foundation issues both directed solicitations to researchers for targeted, multi-year investigations and open-ended “calls for proposals”): they all reflect an effort to balance the relative benefits of steady, predictable funding vs. new initiatives that can yield benefits well beyond (or, for that matter, well below) their tangible cost. We have seen documentation of only one such process for the SRFB (a December 2011 workgroup convened to allocate about \$800,000 of previously uncommitted monitoring funds, as referenced in a Salmon Recovery Funding Board “Briefing Memo” for the

April 2012 Board Meeting, Item 7), but we also recognize that the interest in such possibilities reach well beyond this one-time event.

In general, we recognize the potential for high benefits accruing from even a modest expansion of the funding mechanisms available for monitoring. The greatest difficulty that we see is in providing systematic, technical review at the state level for such requests coming into the SRFB—such a mechanism does not appear to be readily available, but without it such a program would risk becoming another region-based allocation of funds without adequate assessment or oversight. We have seen evidence of poor results from “local” monitoring, because it is commonly subject to shortcomings of no accountability, no meaningful results, and ultimately no outcomes. However, we also see clear indications that some local entities are creating highly functional, useful monitoring programs: for example, the Snake River Region could provide a useful case study for how to “build” a new IMW from the ground up; multiple project examples demonstrate that King County knows how to do (and use) effectiveness monitoring.

These examples suggest the potential benefit of a SRFB-sponsored “initiative fund,” subsequently used as examples to move the entire statewide monitoring enterprise forward. Without adequate in-house technical review capacity available to the Board (and subsequent follow-up accountability imposed on the grantees), however, any such program risks repeating the failed examples of the past—which have, in turn, led to the program as currently implemented.

In addition to considering an open-ended competitive allocation of some funds, the most commonly articulated “missing” component of SRFB-funded monitoring is habitat status-and-trend monitoring. Should this be a SRFB concern? Many say “yes,” from the perspectives of both tracking ultimate success (because fish numbers may be too variable to draw meaningful conclusions) and because it is likely to achieve a rapid level of public understanding. Such evaluations were already expressed in the State of our Watersheds (2012) report from the Northwest Indians Fisheries Commission (<http://nwifc.org/publications/sow/>), but the information there is presented more anecdotally than systematically. The SRFB should have an interest (and potentially a significant role) in supporting a systematic, scientifically based effort along these same lines. However, implementing such a program would need to override the current approach of strict Region-based funding, since only a centrally coordinated, pooled approach would be likely to produce useful results with adequate scientific and statistical rigor. This type of effort appears to be growing in certain regions (Puget Sound, Columbia Basin) without SRFB assistance, and as with more regional efforts at effectiveness monitoring this may be the best (and perhaps only) way to move such an initiative forward.

3 THE INTERRELATIONSHIP OF SRFB MONITORING ACTIVITIES TO OTHER REGIONAL MONITORING

Based on a review of published material, steering committee discussions and the interviews conducted for this study, SRFB monitoring has an insufficient level of engagement with other regional monitoring activities (e.g. USEPA, BPA, NOAA, WDOE, WDFW). We acknowledge the challenge faced by diverse monitoring programs (e.g. different goals, funding cycles, regulatory requirements and constraints), nevertheless a lack of coordination can result in funding inefficiencies, misguided monitoring efforts and a lack of knowledge transfer (e.g. a disconnect between fish and habitat monitoring). That said, there have been efforts to coordinate the programs such as:

- The “Skamania process”, developed for the Columbia River, prioritized monitoring gaps and led to funding from both the SRFB and BPA
- BPA’s Fish and Wildlife program in collaboration with the NWPCC, CRITFC and the ISRP
- The Integrated Status and Trends Monitoring Demonstration Project
- In the Puget Sound, NOAA evaluated the quality of monitoring data, identified data gaps and now the SRFB is funding those gaps
- The annual prioritization process for status and trends monitoring (Table 1). Led by WDFW, this process identifies opportunities for SRFB funding. However it is unclear to what extent the WDFW gaps align with SRFB gaps. Addressing this uncertainty would be value added for the SRFB.
- The development of standardized regional monitoring protocols that enables the SRFB monitoring to integrate with other regional monitoring, thereby expanding the sample size without additional effort or funds.
- The Skagit River IMW has done an exemplary job integrating habitat restoration and fish monitoring from the outset
- TetraTech recently reviewed SRFB effectiveness monitoring sites and identified additional sampling needs that are now being funded by BPA. We recommend that the SRFB continually seek for ways to improve the effectiveness of their funding. One such opportunity is to identify monitoring efforts funded by other entities. Such coordination can provide value added support between monitoring programs. In some cases coordinated efforts will expand the sample population; in others, it may identify overlapping efforts or unnecessary sampling.

4 INFORMATION TRANSFER

Successful monitoring requires the effective dissemination and active exchange of monitoring results (Task 3 of the WP). Doing so can highlight (although not ensure) a level of accountability. Depending on the information exchanged, it can also communicate critical information regarding project effectiveness (e.g., IMW findings that may be applicable to other, similar watersheds and listed species).

Information transfer is one of the major shortcomings of the present monitoring framework in the state, and particularly with those programs directly funded by the SRFB. Although a substantial amount of SRFB-funded monitoring is occurring, only a select group has access to the resulting information: those implementing the work, those who know where to find key reports, those who attend monitoring workshops. In our advanced digital age, information transfer should be operating at a much higher level.

Two web-based systems are presently in place that focus on project tracking, implementation and performance: PRISM and the Habitat Work Schedule (HWS). PRISM, a grant management system employed by RCO and used to apply for SRFB grants (http://www.rco.wa.gov/prism_app/about_prism.shtml), provides publically available information to apply for grants, review information on funded grants, and produce reports about projects. The HWS (<http://hws.ekosystem.us/>), a primary tool of the Effectiveness Monitoring program, is a “mapping and project tracking tool that allows Lead Entities to share their habitat protection and restoration projects with the public... By mapping projects, linking them to each other and

recovery goals, and making it all available on the web, the HWS system makes salmon recovery more accessible to partners, potential funders, and the public.” PRISM and HWS are both useful frameworks for achieving public project accounting and displaying project-specific performance, but neither provides meaningful guidance for future efforts, which should be generated from analyses of monitoring results. As such, these tracking systems are both potentially useful tools, but neither presently supports critical adaptive management needs.

Without regulatory drivers, statutory or contractual requirements, and/or public/agency accountability for funding, these programs (both the monitoring, and the underlying project implementation itself) will continue whether anyone is paying attention or not. Tangible examples of constructive feedback between monitoring results and future management actions are few and far between, and there is scant appreciation of the inherent inefficiencies and lost opportunities that result from a sole reliance on informal, *ad hoc* interactions.

Information transfer is an essential component of an effective monitoring program, but also a daunting mission. PNAMP has facilitated the transfer of monitoring information for other entities funding similar regional monitoring efforts (e.g., BPA). Although SRFB monitoring has engaged with PNAMP on an informal basis, we encourage the SRFB to formalize this relationship in order to significantly expand the current information transfer.

5 CONCLUSIONS

5.1 Opportunities and Limitations of the Present Program

The SRFB faces a laudable, but challenging, set of goals. Thanks to the dedication and groundbreaking work of innumerable scientists and policy makers, there is a wealth of guidance documents, monitoring programs, and monitoring data collected to date. That said, there is also significant need for improvement in SRFB-funded monitoring programs. The most commonly posed question is this: are we sampling the right things, in the right places, using the right methods, at the right time? However, we believe that this question, although important, does not focus on the key challenges facing the SRFB monitoring program, because it addresses the *mechanics* of monitoring but not the underlying purpose for collecting monitoring data and ultimate use of the results.

At the forefront of these potential improvements, the SRFB needs to provide clear and specific leadership to guide the monitoring of salmonid habitat and populations. It is currently not fulfilling that need, nor is anyone else. We respectfully assert that the real issue facing the SRFB is not the need to reallocate monitoring funds, but rather the need to articulate a common set of objectives, a plan to implement those objectives, and a strategy to integrate the results of ongoing monitoring programs, all under the auspices of its centralized leadership. First and foremost, the SRFB needs an explicit framework and process of decision-making with a clear definition of roles and responsibilities to ensure its timely implementation. That framework is the SRFB Strategic Plan, which offers broad goals but currently lacks adequate specificity in the form of clear, measurable objectives, reporting requirements (beyond implementation) and a feedback mechanism based on monitoring results. Such an absence of guidance, evaluation, a timeline (with milestones) and performance metrics creates a void for decision-makers who currently have no clear road map for making decisions.

As an example of the specificity that is currently lacking, consider the fundamental differences between “goals” and “objectives.” Both are necessary to mapping out a successful strategy but

they are not synonymous. Goals are “broad, general statements of what the program, course, or activity intends to accomplish” (from <http://assessment.uconn.edu/primer/goals1.html>, as just one example). Management “questions” are commonly presented in the form of goals. In contrast, objectives are “SMART”: Specific, Measurable, Attainable, Relevant, and Time-bound (see, for example, Doran, 1981, Management Review, Volume 70, Issue 11, pp. 35–36). They describe the tangible path forward towards the attainment of articulated goals. Contrast this framework, however, with the “Objectives” in the *Washington Comprehensive Monitoring Strategy and Action Plan for Watershed Health and Salmon Recovery* (2002): as an example, Objective 1A states “Measure status and track trends of the numbers of spawning salmon by stock in each Salmon Recovery Region. Evaluate whether numbers are improving.” This is neither attainable nor time-bound, and as such provides no real guidance about how to structure a monitoring program nor what activities are the most important to pursue first. Thus, despite the voluminous and carefully thought-out literature of the last decade that provides the intellectual foundation for the SRFB monitoring programs, it has provided insufficient concrete direction or clear criteria against which to evaluate success.

The second overarching limitation of the present program is ambiguity in the appropriate and effective role of the SRFB. Tough technical evaluations and decisions are required to move beyond compliance monitoring, but should the SRFB be making these technical decisions, or should they instead focus on programmatic requirements, coordination and collaboration while seeking scientific input from a technical advisory board (e.g., an ISP)? We observe the latter has been a successful approach for other regional monitoring programs (e.g., BPA) and is worth careful consideration by the SRFB. This was a concern/recommendation that was raised in virtually all interviews conducted for this assessment.

5.2 Levels of Funding vs. Value Provided

Given the relative levels of funding for the three components being reviewed here, this is fundamentally a question of the relative cost/benefit of the most costly component—Intensively Monitored Watersheds—relative to the Effectiveness Monitoring and Status and Trends programs. We agree with the judgment expressed in multiple documents surrounding the formation of the Monitoring Program in general, and the IMWs in particular, that only such a program can answer the fundamental question of any recovery program: Are our efforts doing any good? If this question cannot be answered, it is difficult to justify *any* long-term expenditure on restoration or monitoring; and for the current implementation of salmon recovery in Washington State, IMWs are the only vehicle with the hope of providing an answer.

The current execution of IMWs, however, is not positioned to answer this question, which raises the policy decision of whether the Board considers this to be an important question to answer. If it is, then a secondary issue is raised: is it worth waiting yet another decade with the existing panel of watersheds to learn these answers, or should the Board funding should be redirected or consolidated to other, ongoing IMWs or to an entirely new set. In either case, the Board would need to support funding of projects in those watersheds, independent of any local priorities. The Adaptive Management cycle (and common sense) argues that without a commitment to project funding within these watersheds, there is no sense in providing monitoring funds and effort. The “policy question,” and one that cannot be answered by this review, is thus whether the Board’s interest in scientific understanding and long-term accountability trumps the principle of Regional allocations.

5.3 Recommended Improvements

Based on the information compiled, we identify the following primary issues and recommendations to improve the quality of SRFB-funded monitoring:

- The Effectiveness Monitoring Program should be encouraged to produce more scientifically rigorous and broad-view analyses with explicit recommendations to inform future project design and selection. This critical analysis should be mandatory for all project reports at year 5 and beyond; it should also be a highlighted component of all annual summaries. Good examples are available from the Skagit System Cooperative and could be used as a guide, particularly the additional effort to produce peer-reviewed reports for the scientific literature as a way to move beyond site-specific data reporting to a greater, and more formal, focus on identifying and communicating the broader implications of this work. **Recommendation: evaluate and communicate monitoring results that meet broadly recognized, scientifically rigorous reporting requirements.**
- Build a direct linkage that ensures monitoring results are factored into all projects advanced to the SRFB for funding. Project selection and design must show a clear connection back to prior monitoring results. After a decade of monitoring, there is no need to delay such a requirement to adaptively manage how upcoming projects are designed and implemented. This should occur through various mechanisms, including (1) acceleration of current initiatives to update statewide project design manuals with the findings of prior monitoring; (2) mandatory disclosure in every project application of the way(s) in which prior project monitoring has informed the proposed design; and (3) mandatory articulation by the Local Entities of the way(s) in which prior monitoring (of all types) has informed the selection and prioritization of projects being advanced to the SRFB for funding, especially as it purports to address specific limiting factors for target species. Given the current absence of a strong, centralized technical evaluation review of projects, there is little opportunity to substantively evaluate the quality of any adaptive-management feedback being applied by the SRFB itself, and this ultimately limits the degree to which adaptive management can actually occur. Requiring some acknowledgment of this type of feedback, however, would be a small but constructive step forward. **Recommendation: project design and management decisions should stem from monitoring results, and any such linkages (or their absence) should be disclosed.**
- As the SRFB seeks to improve the “effectiveness” of their monitoring funds, coordination with other regional monitoring programs would be an area to focus such attention. This should be one of the great strengths of the SRFB and is part of its original mandate; we recognize no other entity better positioned to advance this principle. Coordination should be specific, focused and requisite for funding. Areas of suggested focus include – public documentation of SRFB monitoring site locations, protocols, and analytical results. **Recommendation: coordinate specific objectives with other regional monitoring programs (e.g. BPA, PNAMP, USFWS, USFS, OWEB, Regional Monitoring Efforts (e.g. UCSRB)).**
- Large-scale recovery efforts for salmon in the Columbia River face the same challenges posed by the SRFB. As such, this presents an opportunity for collaboration and learning. One notable difference between the two programs is that recovery efforts in the Columbia have been consistently supported by an Independent Science Review Panel (ISRP), whose job it was to examine the scientific merits of restoration actions and associated monitoring. Such as panel, or its functional equivalent, could provide much needed technical support to the SRFB and facilitate many of the other recommendations provided in this report (e.g. develop measureable objectives tied to strategic goals). **Recommendation: if the SRFB**

seeks to maintain a technical review/guidance role in statewide centralized salmon recovery, it should (re)establish a strong technical group to support its needs.

- One of the primary challenges in status and trend monitoring is the lack of coordination between fish monitoring and habitat actions. There is no mechanism, nor requirement, for communication or feedback between the entities and organizations (e.g., project sponsors, lead entities, recovery regions, WDFW, WDOE and SRFB). Spearheading such a need at the technical level is beyond SRFB capacity but is needed nonetheless. Suggestions were made that the Regional Recovery Boards and lead entities may be more effective places to lead such coordination. **Recommendation: recognize the critical need to coordinate fish monitoring and habitat actions, and identify an effective process and entity that can ensure effective integration of their respective program results.**
- A significant percentage of SRFB monitoring funds are allocated to intensively monitored watersheds. Such a disproportionate allocation is justified when the results effectively guide future salmon recovery efforts. However they are not justified in the absence of restoration actions and without direct linkages between a given action and anticipated biological response. **Recommendation: limit IMW funding to watersheds with the ability to implementing restoration projects in a timely manner and with an explicit tie between habitat restoration and fish monitoring.**
- A true, functional adaptive management framework for salmon recovery in the state of Washington is unlikely to occur, given the aforementioned disconnections between the various entities that design, promote, fund, construct, and monitor restoration projects. As with the future implementation of IMWs, the Board is faced with a policy decision with no clear “technical” answer: do the current benefits of regional prioritization and funding allocations supersede the potential benefits of a well-integrated, holistically implemented adaptive-management cycle? Under the status quo, collaboration and regional engagement are prioritized, but it has an inescapable consequence: although measuring and reporting occurs unabated under the various monitoring programs, the best utilization of such information (and, likely the effectiveness of restoration actions as well) is never fully achieved. In order to be effective, adaptive management must operate within the same structure as implementation and monitoring programs. **Recommendation: If statewide recovery goals are to be pursued, establish a true adaptive management program, and align the responsibilities and requirements of the participating agencies with the needs of such a program.**

5.4 Next Steps

The focus of this report was to assess the three primary components of the SRFB monitoring program (effectiveness monitoring, intensively monitored watersheds, and status and trends monitoring). With that assessment and some targeted recommendations now provided in this report, the next step facing the SRFB is to evaluate those recommendations and determine *how* to implement those that best align with the current SRFB mission. Many of the observations and recommendations provided in this report have been raised in earlier forums (such as the 2006 ISP review of the IMW program), but moving beyond recommendations to action has not always occurred. We believe that a major impediment to action is a sense by some partners that the SRFB should play a larger role in overseeing salmon recovery. However, the legislature established the board as a funding board, not a centralized body to oversee statewide salmon recovery. That centralized role of oversight of the state’s salmon recovery strategy is the Governor’s Salmon Recovery Office. The SRFB should work closely with the GSRO to decide the means by which to implement those recommendations judged appropriate.

The SRFB could assist in minimizing the ambiguity by funding or supporting the development of a set of statewide policies, organizations, and scientific decision-making processes, one that would reflect a natural continuation of the statewide Monitoring Strategy advanced over a decade ago. An alternative approach appears to have developed in recent years, with stronger support by the SRFB for region-based salmon recovery—particular for the selection and funding of salmon restoration projects, but with inescapable consequences for monitoring efforts as well. As we have observed throughout this report, certain goals and initiatives of the SRFB—particularly IMWs, systematic analysis and dissemination of effectiveness monitoring results, and adaptive management—require an integrated approach without the distribution of responsibilities, authority, and scientific expertise amongst multiple groups (no matter how well coordinated they may be).

We also recognize the possibility of a hybrid option, wherein the SRFB and the GSRO together transparently and purposefully operate at both scales. In the case of monitoring, for example, two thirds (or more, or less) of the Board’s annual monitoring funds could support the centralized statewide programs for guiding an overall monitoring framework, creating and enforcing adaptive management, and conducting critical science (IMWs, status and trend monitoring, and either an ISP or increased technical staff); the remaining funds could be allocated to regional programs, particularly to improve the region-specific value and feedback of project effectiveness monitoring. The first step, however, must be a clear expression of intent. Regardless of the decision made, it would advance the effectiveness of current SRFB funding and clarify the most appropriate use of resources.

Deciding upon the role of the SRFB and its relationship to the GSRO has significant consequences moving forward. We encourage this issue to receive careful consideration.

6 REFERENCES

See Appendix A.

Appendices

Appendix A

Documents Reviewed (partial list)

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Appendix B

Steering Committee Members

STEERING COMMITTEE MEMBERS

Jen Bayer	Pacific Northwest Aquatic Monitoring Partnership, U.S. Geological Survey
Jeff Breckel	Lower Columbia Fish Recovery Board
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Lance Winnecka	South Puget Sound Salmon Enhancement Group

Appendix C

Interviews Conducted

INTERVIEWS CONDUCTED

Jennifer Bayer	Pacific Northwest Aquatic Monitoring Partnership, U.S. Geological Survey
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Ken Dzinbal	Puget Sound Partnership
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Steve Leider	Washington State Governor's Salmon Recovery Office
Steve Martin	Snake River Salmon Recovery Board
Jenifer O'Neal	Tetra Tech
Tim Quinn	Washington Department of Fish & Wildlife
Phil Rockefeller	Northwest Power and Conservation Council/Salmon Recovery Funding Board
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David Trout	Salmon Recovery Funding Board
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